Conjugated random Gaussian particles model and its application for interpretation of cometary polarimetric observations

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Cometary dust consists of particles of complex composition, shape and structure. Rigorous modeling of light scattering by such particles is very computer time and memory consuming. Moreover, an adequate shape of irregular particles is often hard to be mathematically described. Often cometary dust particles are described as random Gaussian spheres [1]. Based on this approach, we are presenting a model of conjugated random Gaussian particles. This model combines the advantages of random Gaussian spheres of different types since it has a rough surface, both on large and small scales, which makes it convenient for simulations of irregular particles.

A computer simulation of the polarimetric properties of such particles was carried out using the *Sh*-matrix technique [2]. This method is based on the T-matrix technique [3] and was developed after it had been found that the shape-dependent factors could be separated from the size- and refractive-index-dependent factors and presented as a shape matrix, or *Sh*-matrix. Size and refractive index dependences are incorporated through analytical operations on the *Sh*-matrix to produce the elements of the T-matrix. We survey the angular and spectral dependencies of the intensity and polarization resulting from light scattering by such particles, studying how they depend on the particle shape, size, and composition. Polarimetric observations of comets were interpreted, their possible physical and chemical characteristics were inferred, and the range of their variations within which the model is capable to describe the observed data was determined.

References

[1] Muinonen, K., 1996: Light scattering by Gaussian random particles: Rayleigh and Rayleigh–Gans approximations. *J. Quant. Spectrosc. Radiat. Transfer* **55**, 603–613.

[2] Petrov, D., Synelnyk, E., Shkuratov, Y., and Videen, G., 2006: The T-matrix technique for calculations of scattering properties of ensembles of randomly oriented particles with different size. *J. Quant. Spectrosc. Radiat. Transfer* **102**, 85–110.

[3] Mishchenko, M. I., Travis, L. D., and Mackowski, D. W., 1996: T-matrix computations of light scattering by nonspherical particles: a review. *J. Quant. Spectrosc. Radiat. Transfer* **55**, 535–575.

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